

XXVI. *Pseudacraea boisduvali*, Doubl., and its models, with especial reference to Bugalla Island. By G. D. HALE CARPENTER, D.M., Oxon.

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PLATES XXXVII AND XXXVIII.

THIS paper owes very much to the kind help and advice of Prof. Poulton, who is, indeed, the author of its being, for it would never have been undertaken except for his suggestion, nor carried through without his aid and advice. The arrangement of the plates is entirely due to him.

On Bugalla Island, in the Sesse Archipelago, Lake Victoria, during 1912 and January to February 1913, I was able to catch a good series of *Pseudacraea boisduvali*, Doubl., viz. 8 ♂♂ and 12 ♀♀. It frequents the forest, but is most easily caught when it comes to the edge to feed from the flowers of the bush *Haronga madagascariensis*, Chois. (*Hypericineae*), which particularly flourishes where the belt of forest suddenly comes to an end and is replaced by open grass-land. The single large bushes when in flower are extraordinarily attractive to many kinds of insects, and I have seen Planemas, and the forms of *Pseudacraea eurytus*, L., mimicking them, together with *Pseudacraea boisduvali* and various synaposematic red and black Acraeas (*A. egina*, Cram., *A. zetes*, L., and *A. perenna*, D. and H.), all together at the same time, with numerous other insects of the Lycoid synaposeme.

There is considerable difference of opinion as to the appearance of this fine *Pseudacraea* on the wing. Mr. G. A. K. Marshall wrote in 1897 (Trans. Ent. Soc., 1902, p. 504) as follows—"I feel quite satisfied that *Pseudacraea trimenii* [*boisduvali trimenii*] is a mimetic and not a protected species. In spite of its larger size it looks wonderfully like *Acraea acara* on the wing, and the first few examples I caught completely took me in. Their flight is like that of all *Pseudacraeas* and *Euralias*—slow and sailing—so long as they are not disturbed; but if struck at and

TRANS. ENT. SOC. LOND. 1913.—PART IV. (MAR. 1914)

missed they are off like a shot and do not often give one a second chance." The Rev. K. St. Aubyn Rogers, however, who has had experience of this species at Rabai, near Mombasa, is of a somewhat different opinion. In his "Bionomic Notes on British East African Butterflies" (Trans. Ent. Soc., 1908, p. 526) he says, speaking of the difference in flight between the model and the mimic: "Its flight is more lofty and sustained, and when alarmed it goes off at a great rate." This is exactly my own experience, and is the usual case with a mimic of the Nymphaline group: they seem to feel that their appearance will not bear close examination, and if pursued with intent will trust rather to their flight than to their appearance. (Cf. the note on *Precis rauana* in my paper on the *Pseudacraea eurytus hobleji* group, pp. 610, 611). I have never been deceived by *boisduvali*, as I have by *eurytus hobleji*. The *Pseudacraea* has a very much stouter appearance than its Acraeine model, which is a thin-bodied insect of comparatively feeble flight. When at rest on a flower-head the *Pseudacraea* is always on the alert and is difficult to catch, as it takes alarm before one gets within striking distance. The *Acraea*, however, if struck at, and missed, in most cases will return to the same spot.

Rogers (*l. c.*, p. 526) noticed that the integuments of the *Pseudacraea* are very tough, and I have noticed the same thing myself. Although the butterfly is not so resistant to a pinch on the thorax as is its model, yet it is certainly more resistant than *Pseudacraea eurytus hobleji*, with which I have had a large experience.

If one compares the series of 8 males and 12 females from Bugalla Island (Plate XXXVIII, figs. 2, 6, 7, 8, 9, 10) with specimens from other parts of Africa (Plate XXXVII, figs. 2, 4, 11, 13), the island forms appear to be intermediate between the Eastern and South-eastern forms on the one hand and the West Coast forms on the other hand, and in this they agree with specimens caught by S. A. Neave on the mainland of Uganda—a male and a female from the N. shore of the lake near Kampala, and a male and two females from the W. shore in Buddu. Let us consider the *males* first.

The mimetic resemblance of the male Pseudacraea boisduvali both East and West.—In the Hope Collection at Oxford is a long series of the Eastern form, as follows, following an order from N. to S. :—

30 caught by the Rev. K. St. A. Rogers at Rabai,
near Mombasa, Br. E. Africa.

1 caught by the Rev. H. Rowley, from "the Zambesi."

2 caught by C. F. M. Swynnerton in S.E. Rhodesia
(Chirinda forest).

6 caught by G. A. K. Marshall in Natal.

1 caught by G. H. Burn in Natal.

22 bred by the late A. D. Millar at Durban, Natal.

These 62 males show that more than half of the Eastern examples have a well-developed orange-yellow subapical bar on the fore-wing (Plate XXXVII, fig. 11). This same peculiarity is well marked also in the model of the Eastern *boisduvali* (or *boisduvali trimeni*, Butl.), namely the *acara*, Hew., race of *Acraea zetes*, L. (fig. 10). In some males of *trimeni*, on the other hand, this bar has almost or quite disappeared (as in 5 from Mombasa, 4 from Durban, and 1 from S.E. Rhodesia), or else is very faintly represented by that part of it near the hind-margin of the wing (as in 9 from Mombasa and 6 from Durban). Subtracting these, we get $62 - 25 = 37$, out of 62, with well-developed orange bar, so that this form is slightly predominant in the *East* and *South-east*; and specimens with a less but still fairly well-developed orange area are very common. In the specimens from *West Africa*, of which, however, there are only 2 males and 1 female in the Hope Department, this orange area hardly appears; the Sierra Leone specimen shows no trace of it (Plate XXXVII, fig. 2), and an Angola specimen only that end of it close to the hind-margin of the wing.

Now in the Uganda males (Plate XXXVIII, figs. 2, 6, 7), in *no* case is the orange bar so well developed as in the 37 Eastern males, and in only half of them is it in the same condition as in the Angola specimen. Hence, as regards the non-development of the orange bar, the Uganda males approach most nearly to the Western form. The Western form, as was first pointed out by Haase (see pp. 651, 652), mimics *Acraea egina* and not *Acraea zetes*, and the Uganda males also mimic *A. egina*, although *zetes* abounds on Bugalla Island.

There is another point of interest in the mimicry of the male *Acraea zetes acara* by *Pseudacraea boisduvali trimeni* (formerly *Ps. trimeni*, when the East African form was regarded as a distinct species). Many specimens of ♂ *zetes*

from Natal, Rhodesia, etc., show a white irradiation of the centre of the hind-wing, and this is also present in a certain number of the *Pseudacraeas* from the same localities. This white irradiation has been beautifully shown in Eltringham's magnificently illustrated "African Mimetic Butterflies," Oxford, 1910 (Plate 6).

At Mombasa, in British East Africa, however, where the *zetes* are still of the Eastern form with a well-marked orange bar on the fore-wings, none of the Oxford specimens show the white irradiation, and neither do the *boisduvali*, save for the minutest trace along a few nervules, which is only visible on very close inspection, as in fig. 11, Plate XXXVII. In the photograph the white is more conspicuous than in the actual specimen.

Now let us turn to another point. The *Western* form of the male (which we may now call *boisduvali boisduvali* in contradistinction to the Eastern *boisduvali trimeni*), as illustrated by the two specimens in the Hope Department, shows, at the base of the fore-wings, a very marked suffusion with black, which replaces the red colour over approximately the basal half of the wing. This is particularly well shown in the specimen from Sierra Leone (Plate XXXVII, fig. 2), but the other, from Angola (Hewitson, 1873), which is in poor condition, does not show this so clearly. It may be remarked here that as we reach the more southern latitudes of the tropical West Coast an Eastern affinity begins to appear not only in *Ps. boisduvali* but in other species as well. The darkening of the fore-wing basal area is exactly the change most needed to produce a likeness to *Acraea egina*, which differs from *A. zetes acara*, amongst other less conspicuous points, in having the red colour on the fore-wing replaced by black over this very part of the surface. (Compare figs. 1 and 10 on Plate XXXVII.) Now, out of the whole number of specimens of the East African male *boisduvali trimeni* in the Hope Department, only one, taken by the Rev. K. St. Aubyn Rogers near Mombasa, Dec. 29, 1906, shows this black suffusion over the base of the fore-wing at all well marked. This was described as an interesting link between *trimeni* and *boisduvali* proper by Trimen in an appendix to Rogers' paper on the "Bionomics of East African Butterflies" in these Transactions, 1908, p. 552. But, on comparing the males from Uganda (8 from Bugalla Island and 2 from the mainland) one finds this basal black very

well marked indeed in 6 of the 8 island specimens (Plate XXXVIII, figs. 2, 6, 7), and one of the two mainland specimens (from Kampala). In another island specimen, and the second mainland male (from Buddu) the basal suffusion is less marked, though it is nevertheless more pronounced than in the Eastern *trimeni* form. In the remaining island male the basal black is only just noticeable (as it is in one specimen bred by the late A. D. Millar in Natal and the one caught by Rogers near Mombasa).

If we then consider these two points, namely, the degree of development of the orange subapical area, and the basal black suffusion, the conclusion is irresistible that the ♂ *Ps. boisduvali* in Uganda (Plate XXXVIII, figs. 2, 6, 7) is intermediate between the *trimeni* form of the East with well-developed orange bar and no basal black (Plate XXXVII, fig. 11), and the true *boisduvali* form of the West, with no orange and well-developed basal black (Plate XXXVII, fig. 2), but that on the whole it is nearer to the latter and more closely resembles *Acraea egina*, the Western model, than *Acraea zetes*, the Eastern model, although, as I have said, *zetes* is plentiful enough on the island.

In testing this conclusion by comparing the figures on Plates XXXVII and XXXVIII, it is necessary to make allowance for the difficulty of representing black, red and orange in their full values by means of a plate prepared from a photograph, however good. By screening, long exposure, and sensitive plates, Mr. Alfred Robinson has produced very fine results, but the added advantage of colour is indispensable for the adequate representation of such butterflies as the forms of *Pseudacraea boisduvali* and their models.

As regards the red spots along the black margin of the hind-wing, the Bugalla *Pseudacraeas* come nearer to *zetes*, but this is a comparatively inconspicuous feature. It is an extraordinarily interesting thing that *boisduvali* should, on the West Coast, forsake its Eastern model for another species (a representative of which is present as *egina areca*, Mab., on the East Coast), although its Eastern model has a common Western form, *zetes zetes*. Large collections made without prejudice might explain this by showing that *egina* is predominant in the West as *zetes acara* certainly appears to be in the East, but this is yet to be done.

A further complication is introduced into this intricate question by the interrelation between the two species of *Acraea* themselves and their place in a large combination of dark fore-winged *Acraeas* in West Africa. In this combination *egina* is probably the predominant form, and has played the principal part in the Western modification of *zetes*. Thus, in the Western ♂ *zetes* (Plate XXXVII, fig. 5) the red area of the fore-wing is much contracted, resembling the smaller area of *egina* (fig. 1). Specimens of this kind occurred on Bugalla Island (fig. 7), some showing it even more markedly than the one figured. Others, however, were still of comparatively Eastern form (fig. 8), so that, on Bugalla Island, there was a true mixture of the two geographical races, as is so often found in Uganda where East and West *do* meet around the shore of the great Lake Victoria.

It may be noted that on Bugalla itself *egina* and perhaps *perenna*, D. and H., are the only *Acraeas* which are likely to have taken any part in the transformation of *zetes*.

It will be of interest here to note the gradual development of our knowledge of the relationship between *Pseulacraea boisduvali* and its *Acraeinae* models. Trimen says, in an appendix to Rogers' paper mentioned above, 1908, p. 552: "in 1869 (Trans. Linn. Soc. Lond., xxvi, p. 517)," and later in 1887 and 1889 ("S. Afr. Butterflies," i, p. 298; iii, p. 405), "I showed how closely in both sexes *trimenii*, the South-Eastern form, copied *Acraea acara*, Hewits., of the same region, just as *boisduvalii* mimicked the West African *Acraea zetes*, Linn." Later on he continues (p. 553): "I am now able, . . . to record the occurrence in a British East African series . . . of a ♂ *trimenii* from 'Rabai, near Mombasa (K. St. A. Rogers) . . .,' in which the sub-apical bar of fore-wing is very much reduced and narrowed (while the red spots in the hind-marginal border of hind-wing are unusually large),—having the fore-wing fuscous suffusion largely developed, so that the usual red ground colour is obliterated except for a large sub-quadrate space at posterior angle as in *P. boisduvalii*, and a slight sub-basal trace. This example is a most distinctly intermediate link between the Western and Eastern forms . . ."

In a footnote he adds: "Haase (Untersuch. über die Mimicry, etc., 1893, p. 43, taf. 4, ff. 26–28) showed that *boisduvalii* mimicked *A. egina*, Cram., more closely than

A. zetes, at any rate as far as the ♂ is concerned, that sex having a red patch along outer portion of inner margin of fore-wing, just as in *egina* ♂, and larger than is exhibited by *zetes* ♂, while in hind-wing larger black spots characterise both *egina* and *boisduvalii*. On the other hand, as regards the presence of red spots in the hind-marginal border of hind-wing, *boisduvalii* resembles *zetes* and not *egina*."

Prof. Poulton alludes to this curious changing of resemblance to another model on the West Coast, in a note to Rogers' account of *Ps. trimeni*, as follows (*l. c.*, p. 528):—

"There can be no doubt that the eastern sub-species *trimenii*, with its conspicuous subapical yellow-ochreous fore-wing bar, mimics *Acraea acara* (in which the apical portion of the fore-wing is warm reddish-ochre), and bears no very close resemblance to *areca* or to any of the other large red black-marked, eastern *Acraeas*. The western *boisduvalii*, on the other hand, is a much closer mimic of *Acraea egina*, the western representative of *areca*, than it is of *zetes*, the representative of the eastern model of *trimenii*. This is all the more remarkable because *zetes* is replaced by *acara* in the Cameroons, as I was astonished to find in the collection of the Brussels Museum.

"This mimetic relationship is unusual, and is all the more remarkable because the eastern mimic is transitional into the western, the eastern model into the western *zetes*, the western model into the eastern *egina*."

The mimetic resemblance of the female Pseudacraea boisduvali.—It is the mimicry by the Bugalla Isle female which finally clinches the evidence that the Western *Pseudacraea boisduvali* mimics *Acraea egina*; for there exists on the island a peculiar variety of female *egina*, which is evidently drawing the local female *Pseudacraea* towards itself.

This island female of *A. egina*, named *alba* by Eltringham (*Trans. Ent. Soc.*, 1913, p. 412), approaches very closely to the subspecies *medea* of Cramer, which is also an island form and at present only known from Prince's Island in the Gulf of Guinea. The female *medea*, Cram., is dull white with all the spots very large and prominent (Plate XXXVIII, fig. 5)

The Bugalla females of *egina* (figs. 3 and 4) only differ from *medea* in that the hind-wings are not so white but exhibit a very slight brownish tint, so that they are to some extent intermediate between the typical *egina* and

the Prince's Island form. On the lower surface, the wings show a little more yellowish tint than in the true *medea*, in this also being intermediate between the type and this subspecies.

Unfortunately I only caught four specimens, not realising at the time the interest attaching to them, so that I cannot show from my own experience that they are the only form of female *egina* on Bugalla Island. That they are the only form is also indicated by Grünberg (Trans. Ent. Soc. Lond., 1913, p. 412), and I hope to put the matter beyond doubt on my return to Bugalla; for *egina* is an abundant species there. I was struck with the general likeness of this pale form to *Planema consanguinea albicolor*, Karsch (*arenaria*, E. M. Sharpe), when seen at a little distance on a flower head.

Now the Bugalla females of *Pseudacraea boisduvali* are also peculiar in the large development of a white suffusion on the fore-wings. This varies much in degree in the twelve specimens, but in that which shows it best (Plate XXXVIII, fig. 10) there is a white subapical area, and much of the basal half of the fore-wing is whitish, a pinkish tint being confined to the base. The hind-wings are of a dull brownish, like those of a typical ♀ *egina*, but there is a whiter patch on the anterior margin. The likeness of this specimen to its model (Plate XXXVIII, figs. 3 and 4) is further accentuated by the row of heavy black spots just internal to the subapical white patch on the fore-wing. These spots are only just indicated in the other specimens (figs. 8, 9), but they form a characteristic marking of the model.

In none of the 12 Bugalla females is there the large yellow subapical patch which is a conspicuous feature of the Eastern ♀ *boisduvali*, which resembles *Acraea zetes acara*, though in 9 of them the white patch which takes its place has a trace of yellow suffusion at the hind-marginal end.

In these points they agree with Neave's 3 specimens from the mainland of Uganda. None of Neave's, however, show the white suffusion over the base of the fore-wing, so characteristic of the Bugalla specimens, and not shown in any of the 39 Southern and Eastern forms. The Western female of *boisduvali* is represented in the Hope Department by two specimens, one of which comes from Sierra Leone, and was purchased in 1901 from Watkins and Doncaster. In this (Plate XXXVII, fig. 4),

which mimics the *typical* female *egina* (fig. 3), the fore-wings are grey-brown with neither white nor yellow subapical area, and only a faint trace of pinkish brown suffusion at the anal angle. The hind-wings are red brown, resembling those of the *egina* female. The second Western ♀, taken by Neave in the S.E. of the Congo State, about 150–200 miles W. of Kambove, in 1907, has the typical appearance of an Eastern female. This is in accordance with the affinities displayed by other species from the same area.

The conclusion is that the female, as well as the male, *Pseudacraea boisduvali*, of Bugalla Island, L. Victoria, follows the typical Western form in mimicking *Acraea egina* instead of *Acraea zetes*; the evidence being peculiarly convincing because the ♀ *egina*, but not the ♀ *zetes*, appears as a striking local form which is mimicked by the ♀ *Pseudacraea*. In the male the resemblance to the model is not quite so perfectly developed as in the Western form, it being intermediate between that and the Eastern form, although much nearer to the former, as in certain other Uganda species which range from East to West.

Addendum.

Since writing the above I have had, through the kindness of Mr. Roland Trimen, F.R.S., an opportunity of examining the *Ps. boisduvali* in his private collection, containing a fine series of specimens bred in 1910 by the late A. D. Millar, at Durban.

In this series there are 12 males and 13 females.

Of the 12 males, 6 were of the typical, highly-coloured Eastern form with very conspicuous large orange-yellow subapical area on the fore-wing. In 4 males the orange area was smaller, and from two only was it absent. One of the specimens with much orange had well-defined black suffusion over the base of the fore-wing, but none of the others exhibited any signs of this.

Of the 13 bred females, 10 were of the typical Eastern form, with well-marked orange areas on the fore-wing; the other 3 had the yellow much reduced, or whitish in colour.

Mr. Trimen also has 2 females, caught, one in Zululand and one at Malvern in Natal. These are typically Eastern, and one has a very slight suffusion with white on the hind-wing about the centre.

